2016 Spring CS300 Homework #3

Due: April 18 (AM) 10:30 on classroom

TA in charge: Soowon Kang (suwon419@kaist.ac.kr)

Reference Textbook: Introduction to Algorithms

1. Sorting variable-length items

a. You are given an array of integers, where different integers may have different numbers of digits, but the total number of digits over all the integers in the array is n. Show how to sort the array in $O(n)$ time.

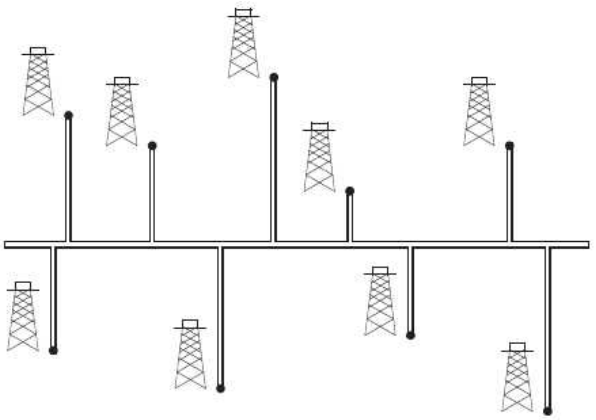
b. You are given an array of strings, where different strings may have different numbers of characters, but the total number of characters over all the strings is n. Show how to sort the strings in $O(n)$ time.
(Note that the desired order here is the standard alphabetical order; for example, $a < ab < b$.)

2. Exercises in Medians and Order Statistics

a. In the algorithm SELECT, which was learnt in the lecture, the input elements are divided into groups of 5. Will the algorithm work in linear time if they are divided into groups of 7? Argue that SELECT does not run in linear time if groups of 3 are used.

b. Show how quicksort can be made to run in $O(n \log_2 n)$ time in the worst case, assuming that all elements are distinct.

c. Professor Lee is consulting for an oil company, which is planning a large pipeline running east to west through an oil field of n wells. The company wants to connect a spur pipeline from each well directly to the main pipeline along a shortest route (either north or south), as shown in the following Figure . Given the x− and y−coordinates of the wells, how should the professor pick the optimal location of the main pipeline, which would be the one that minimizes the total length of the spurs? Show how to determine the optimal location in linear time.



3. Exercise in Dynamic Programming

− Give a quadratic−time algorithm to find the longest monotonically decreasing subsequence of a sequence of n numbers.